one or more sides of the sensor element. In some of the referenced patents, the fluid filled void enhances sensor sensitivity, however, the voids provide enhanced sensitivity for the entirety of the sensor surface area rather than improving sensitivity at selective locations within the surface area of the element.

In each of the referenced patents, sensor arrays are formed by multiple discrete elements each of which populate a point in space. In each of the referenced patents, the sensor elements operate by a single means of stimulation; either compressing or bending the piezoelectric sensor material. None of the referenced applications teach or suggest forming a sensor by employing one stimulation method at one location within the sensor and another method at another location as claimed in claim 1.

The referenced patents are in stark contrast to the concept of the present invention, a hybrid array that employs a single sensor element having a continuous surface area within which are multiple locations of enhanced acoustic sensitivity. The single element exhibits properties of a continuous spatial array (line or surface) and that of an array of discrete elements. The continuous film (and hence continuous electrical conductors) greatly reduces the number and complexity of electrical wiring. The electrical signal produced by the entirety of the continuous film sensor is accessed at two contact points as claimed in claims 11, 18 and 23. The referenced patents did not anticipate these concepts.

The following paragraphs provide further patentable distinctions and detailed contrasts of the referenced patents and the present invention, a hybrid sensor.

Carson, et. al. (US 5,406,163) describes an array formed by multiple discrete sensor elements. These constituent elements are electrically and mechanically separated from each other. Sensor sensitivity is achieved by compression of a piezoelectric film in the thickness direction only. Voids beneath the sensing element enhance sensitivity by reducing the adverse effect of parasitic electrical capacitance rather than stretching the sensor material over the void. Electrical connection to the many discrete elements requires at least one unique contact point for each of the many discrete elements plus a common "ground" conductor.

Fromont, et. al. (US 5,517,467) describes an array of discrete sensor elements physically separated from each other. The sensor elements are flexible (to bend around curved surfaces) but the sensors are not responsive to bending strain. Instead, each element is stimulated by straining the peizoelectric film in only the thickness direction. The elastomer-filled gap between the sensor film and the sensor backing is uniformly distributed for the entirety of the sensor surface and so does not selectively enhance sensor sensitivity at particular points on the surface of the sensor. Electrical connection to the many discrete elements can be accomplished by a contiguous thin film with appropriate cutouts between discrete elements to facilitate flexibility. Signals from each of the many discrete elements are combined in parallel. Thin film conductors between rows or columns of sensor elements may be severed to form sub-arrays of uniformly spaced discrete elements. The sensor elements may be formed from continuous sheets of piezoelectric film but cut into small pieces to form the discrete sensor elements.

Bernstein (US 5,956,292) describes an array of multiple discrete elements each of which are physically and electrically isolated from each other. Each element is stimulated by bending a piezoelectric film over a void. In some embodiments, sensor sensitivity is enhanced by attaching piezoelectric film at the hinge point of a cantilevered surface area that increases the acoustic aperture of the sensor. Enhanced sensitivity affects the entirety of the sensor rather than selective portions of the sensor. Electrical connection to the many discrete elements requires two conductors for each element. The electric contacts are selectively enabled to form an array of differing directivity.

Yamamuro, et. al. (US 3,832,580) describes discrete piezo-electric transducers that operate in the bending mode only. Elastomer filled voids beneath the piezo-film function to shape the bending mode of the transducer to affect desired performance. The inventors do not allude to mixing strain modes within the film to achieve directivity. Multiple transducer "motors" are wired together to gain desirable effects.

Thus it is believed that the claims 1-3 and 9 as amended, remaining claims 4-8 and 10, and new claims 24-33 are patentably distinct over the references cited by the Examiner. Pursuant to 37 CFR 1.121, a marked-up set of amended claims showing changes is attached on a separate page.

Respectfully submitted,

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Date

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